

REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended the independent claims (claims 12, 17, 18 and 22) to recite, in a “whereby” clause, that water is retained by capillary force by the water-retaining layer when the fuel cell is not working, and is taken by gas against the capillary force when the fuel cell is working. See, for example, the paragraph bridging pages 9 and 10 of Applicants’ specification, especially together with the paragraph bridging pages 23 and 24 of Applicants’ specification. Moreover, Applicants have further amended claim 17 to delete the word “the”, when first reciting flow channels of the fuel gas and the oxidizing gas; and have amended claim 22 to recite a humidifier. In addition, Applicants have amended claim 23 to be dependent on claim 22.

Initially, it is respectfully requested that the Examiner reconsider and withdraw the finality of the Office Action mailed August 3, 2006, whereby the present amendments are to be entered as a matter of right. In this regard, attention is respectfully directed to the new basis for rejection of claim 17, set forth in Item 6 on page 3 of the Office Action mailed August 3, 2006. That is, the Examiner has rejected claim 17 on the basis that the recitation “the flow channels” in line 6 has insufficient antecedent basis therefor. However, note that claim 17 as considered by the Examiner in the Office Action mailed March 14, 2006, included the recitation of “the” flow channels, and the Examiner did not reject claim 17 on this basis in the Office Action mailed March 14, 2006 (the Examiner rejecting claim 17 in this Office Action mailed March 14, 2006, under the second paragraph of 35 USC 112 in that the recitation “said water retaining member” has insufficient antecedent basis). See Item 9 on page 3 of the Office Action mailed March 14, 2006.

In view of the new basis for rejection of claim 17 under the second paragraph of 35 USC 112, set forth in the Office Action mailed August 3, 2006, which was not necessitated by Applicants' amendments to the claims in the Amendment submitted June 14, 2006, it is respectfully submitted that the Examiner could not properly make the Office Action mailed August 3, 2006, a Final Office Action. In view thereof, reconsideration and withdrawal of the finality of the Office Action mailed August 3, 2006, and entry of the present amendments as a matter of right, are respectfully requested.

Moreover, in the Amendment filed June 14, 2006, Applicants incorporated subject matter of claim 14 into, inter alia, claim 12, the Examiner having indicated in the prior Office Action of March 14, 2006, that the subject matter of claim 14 was allowable, notwithstanding this, the Examiner rejected amended claim 12 on new prior art grounds, in the Office Action mailed August 3, 2006. It is respectfully submitted that, in addition, in view of this new basis for rejection of claim 12 (containing what the Examiner had previously indicated was allowable subject matter), the Examiner could not properly make the Office Action mailed August 3, 2006, a Final rejection.

The contention by the Examiner in Item 1 on page 2 of the Office Action mailed August 3, 2006, that such Office Action is made final "as necessitated by the amendments", is respectfully traversed, insofar as applicable to at least the rejection of claim 17 under the second paragraph of 35 USC 112 and the rejection of claim 12 on new prior art grounds. As set forth in the foregoing, clearly the basis for rejection of claim 17 under the second paragraph of 35 USC 112 set forth in Item 6 on page 3 of the Office Action mailed August 3, 2006, existed in claim 17 as previously considered by the Examiner in the Office Action mailed March 14, 2006. Clearly amendments made by Applicants in the Amendment submitted June 14, 2006 did not necessitate

the new basis of rejection of claim 17. Moreover, amendments made to claim 12 did not necessitate the new prior art rejection thereof. At least in light of these new bases of rejection of claims 12 and 17, not necessitated by Applicants' amendments to their claims in the Amendment submitted June 14, 2006, the Office Action mailed August 3, 2006, cannot properly be made Final.

In any event, it is respectfully requested that the present amendments be entered. Noting, for example, bases for rejection of the claims under the second paragraph of 35 USC 112, set forth in Items 6-8 on page 3 of the Office Action mailed August 3, 2006, as well as the new bases for rejection of claims on prior art grounds, using, inter alia, the newly cited U.S. patent to Nakao, et al., it is respectfully submitted that the present amendments clearly materially limit issues remaining in connection with the above-identified application, and at the very least, present the claims in better form for appeal. Noting prior arguments made by Applicants, e.g., in the Amendment submitted June 14, 2006, it is respectfully submitted that the present amendments do not raise any new issues, including any issue of new matter; and, it is respectfully submitted that the present amendments are clearly timely, especially in view of the new grounds and bases for rejection set forth in the Office Action mailed August 3, 2006.

In view of the foregoing, it is respectfully submitted that Applicants have made the necessary showing under 37 CFR 1.116(b)(c); and that, accordingly, entry of the present amendments is clearly proper, even if the Finality of the Office Action mailed August 3, 2006, is maintained.

Applicants respectfully traverse the rejection of claims 17, 18, 22 and 23 under the first paragraph of 35 USC 112, as failing to comply with the written description requirement, especially in light of the following comments. Thus, the Examiner has

rejected claims 17, 18, 22 and 23 on the basis that Applicants' specification fails to disclose "humidifying the oxidizing gas fed to the cathode". Note Item 4 on bridging pages 2 and 3 of the Office Action mailed August 3, 2006. However, the Examiner's attention is respectfully directed to the paragraph bridging pages 23 and 24 of Applicants' specification. Note, in particular, the following sentence in this paragraph:

"Although this embodiment is not equipped with a humidifier for the anode gas as the cathode PEM 102 can humidify the gas fully with water generated by power generation, it is possible to provide a cathode gas humidifying means in the cathode gas flow channel." [Emphasis added]

Note also the first full paragraph on page 4 of Applicants' specification, generally describing that the polymer electrolyte fuel cell is provided with a humidifier having a porous material, without specifically stating that the such humidifier is only provided for the anode.

In addition, attention is respectfully directed to original claim 1, describing a humidifier "to humidify at least the oxidizing gas to be fed to said anode" (emphasis added); and original claim 12, reciting that the humidifier humidifies the oxidizing gas. Of course, the original claims form part of the original disclosure.

Taking Applicants' original disclosure as a whole, including specific portions thereof referred to in the foregoing, it is respectfully submitted that such disclosure clearly establishes that Applicants contemplated as part of their original invention, an assembly including a humidifier which humidifies the oxidizing gas fed to the cathode. Accordingly, it is respectfully submitted that the rejection of claims 17, 18, 22 and 23 under the first paragraph of 35 USC 112, as failing to comply with the written description requirement, is in error. Reconsideration and withdrawal of this rejection is respectfully requested.

The rejection of claims 17, 22 and 23 under the second paragraph of 35 USC 112, for reasons set forth in Items 6-8 on page 3 of the Office Action mailed August 3, 2006, is noted. Applicants have amended claim 17 to delete the word "the", in connection with first recitation of the flow channels of the fuel gas and the oxidizing gas; in view thereof, it is respectfully submitted that any question concerning insufficient antecedent basis for "the" flow channels in claim 17 is moot.

Moreover, Applicants have amended claim 22 to recite that the fuel cell assembly includes, inter alia, "a humidifier", and claim 23 has been amended to be dependent on claim 22. In view of these amendments to claims 22 and 23, it is respectfully submitted that there is clear antecedent basis for recitation of "said humidifier" in claims 22 and 23.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed August 3, 2006, that is, the teachings of the U.S. patent documents to Nakao, et al., U.S. Patent No. 4,909,810, and to Mossman, Patent Application Publication No. US 2001/0046616 A1, and the Japanese patent documents to Kawazu, No. 08-138704 (hereinafter Kawazu), to Kawazu, No. 08-138705 (hereinafter NO. 08-138705) and to Karakane, et al., No. 2000-173633, under the provisions of 35 USC 103.

It is respectfully submitted that the references as applied by the Examiner would have neither taught nor would have suggested such a fuel cell assembly as in the present claims, having, inter alia, a humidifier, wherein the humidifier humidifies at least one of the oxidizing gas and the fuel gas, and wherein this humidifier includes a water-retaining layer having a mean micro-pore diameter of 10-300 μ m and a thickness of 50-300 μ m, whereby water is retained by capillary force by the water-

retaining layer when a unit fuel cell is not working and is taken by the oxidizing/fuel gas against the capillary force when the unit fuel cell is working. See claim 12; note also claims 17, 18 and 22.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such fuel cell assembly as in the present claims, having features as in independent claims 12, 17, 18 and 22 as discussed previously, and additionally having features as set forth in the present dependent claims, such as (but not limited to) wherein the porous member (of which the water-retaining layer is made) is made of a hydrophilic polymer material, a carbonaceous porous material, or a composite material thereof (see claim 2); and/or wherein the thickness of a humidifying water inlet of the humidifier is $\frac{1}{2}$ to $\frac{3}{4}$ of the thickness of the porous member (see claim 3); and/or wherein a water permeable membrane having a function to transmit water is formed on porous material of the water-retaining layer (see claim 4), more particularly, the size and porosity of the water permeable membrane respectively as in claims 5 and 6, and material of the water permeable membrane as in the claim 7; and/or wherein the water-retaining layer of the humidifier has a carbonaceous porous filter, as in claim 8; and/or wherein this porous member has a hydrogen-oxidizing catalyst dispersed therein (see claim 9), or wherein the humidifier is provided for each or a group of the unit fuel cells (see claim 10); or a power generation system including, inter alia, the fuel assembly of claim 18, as in claim 11; and/or wherein the water-retaining layer has a hydrophilic porous member as in claim 13; and/or wherein the water-retaining layer has a porous member provided opposite to the unit fuel cell and has a water supplying surface, with water being supplied from part of a surface opposite to the water supplying surface of the porous member and/or from the outer edge of the porous member (see claim 16);

and/or wherein water retained in the water-retaining layer is supplied to the flow channels from at least one of part of the opposed surface of the porous member and the outer periphery of the porous member (see claim 19); and/or wherein the fuel cell assembly has at least two water retaining layers (see claim 20); and/or wherein the carbonaceous porous filter controls flow rate of water to the water-retaining layer (see claim 21); and/or wherein the water-retaining layer is a material as set forth in claim 23.

The invention as claimed in the above-identified application is directed to a fuel cell assembly including at least one unit fuel cell, and a power generation system using such fuel cell assembly. In particular, the present invention is directed to such fuel cell assemblies, including polymer electrolyte fuel cells.

As described on page 1 of Applicants' specification, a unit fuel cell of the polymer electrolyte fuel cell (PEFC) includes a membrane-electrode assembly having a proton exchange membrane, which is a proton-conductive membrane sandwiched between porous electrodes, and a unit cell separator having gas flow channels which supply hydrogen gas to the anode and air (oxygen) to the cathode, respectively. The proton exchange membrane must be kept wet to a certain level, to let protons move; and various mechanisms have been proposed as apparatus to humidify fuel gasses, as described on pages 2 and 3 of Applicants' specification. Various previously proposed humidifiers have problems such as consuming power, which reduces efficiency of the fuel cell system.

Against this background, Applicants provide a fuel cell assembly including a humidifier, which avoids problems of previously proposed humidifiers, avoiding a reduction in efficiency of the fuel cells. Applicants have found that by utilizing, for the humidifier, a water-retaining layer having a mean micro-pore diameter and thickness

as in the present claims, particularly wherein this water-retaining layer is made of a hydrophilic porous member, and whereby water is retained by capillary force by the water-retaining layer when the at least one unit fuel cell is not working and is taken by the oxidizing/fuel gasses against the capillary force when the at least one unit fuel cell is working, excess humidification of the fuel/oxidizing gasses can be avoided, and a simple and effective humidification of the fuel/oxidizing gasses can be provided. Note, for example, the paragraph bridging pages 9 and 10, as well as the sole full paragraph on page 10, of Applicants' specification.

Moreover, the gasses can be humidified to required degrees according to the flow rate of the gasses, by a simple and efficient technique forcing the water to the gasses fed to the anode and cathode against the capillary force when the at least one fuel cell is working.

It is emphasized that according to the present invention, the humidifying water humidifies the fuel gas and/or oxidizing gas when there are gas-flows, e.g., upon starting and operation of the fuel cell; and when the fuel cell is stopped to stop the gas-flow, water is retained in the micro-pores by the capillary action. Accordingly, the water-retaining layer properly humidifies the fuel gas and/or oxidizing gas, without excessively humidifying the gas.

Kawazu discloses a hydrogen gas humidifier constituted with a porous film, and separated which interpose the porous film from both sides and form a hydrogen gas flow path and a water flow path respectively. The porous film is a polyolefin porous film and has hydrophilic nature. This patent document discloses that water is easily vaporized by receiving heat from both the porous film and the hydrogen gas, and humidification is conducted in a state of steam.

It is emphasized that according to Kawazu, humidification is conducted in the vapor state (of steam). It is respectfully submitted that the technique of humidification in Kawazu is entirely different from that according to the present invention, wherein water is retained by capillary force by the water-retaining layer when the at least one unit fuel cell is not working and is taken by gas fed to the anode and/or cathode against the capillary force when the at least one unit fuel cell is working. Clearly, Kawazu would have neither taught nor would have suggested the presently claimed subject matter, including the water-retaining layer of the present claims, including dimensions thereof, and how the humidifier functions.

It is respectfully submitted that Kawazu discloses controlling permeability of the hydrophilic porous member by adjusting a pressure difference between a gas pressure and water pressure. The hydrophilic porous membrane used in Kawazu has a porosity of 50% or more and a mean pore diameter of 0.05 micrometer or the like, which transmits water in accordance with the pressure difference. The water is formed on the surface of the porous membrane in Kawazu; it is respectfully submitted that in view of the small pore diameter in Kawazu, water would not be retained in the micro-pores thereof.

In paragraph [0131] of Kawazu, a gas humidifier 3000 is constituted by a plurality of porous membranes 3100 (though only one membrane is shown in Fig. 17, which is called a first porous membrane), and plates 3110 for holding the membranes from their sides. The first porous membranes 3100 have a pore diameter of 1 micrometer, a porosity of 83% and a thickness of 35 micrometers, and are made of a hydrophilic fluorine group precision filtering membrane. Kawazu discloses that in this structure there is a second porous membrane 3200, having a pore diameter of 55 micrometers, porosity of 55% and a thickness of 2 mm. Clearly, this aspect of the

teachings of Kawazu would have neither taught nor would have suggested the water-retaining layer of the present claims, including recited dimensions thereof and functioning thereof.

Karakane, et al. discloses a solid polymer fuel cell which enables maintenance of the wet state of the whole solid polymer film, the fuel cell including a water-holding layer formed on the side facing to a fuel electrode of a rib-equipped plate which forms channels through which water, that is, a wetting agent, flows. This patent document discloses that the water-holding layer 402 is formed by spraying a mixture of resin dissolved in a solvent with carbon, then drying it a prescribed temperature; and that a wet-holding capacity per electrode action area of the wet-holding layer is regulated to 0.002-0.0135 g/cm².

It is respectfully submitted that Karakane, et al. would have neither taught nor would have suggested the water-retaining layer of the present claims, including dimensions thereof and functioning thereof.

It is respectfully submitted that the teachings of Nakao, et al. would not have rectified the deficiencies of either one of Kawazu or of Karakane, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Nakao, et al. discloses a (water) vapor permselective membrane and a method for selectively permeating and separating water or water vapor from a moisture-containing gas by means of an ion exchange membrane, for production of moisture-reduced air or for removal of moisture. See column 1, lines 4-18. The vapor permselective membrane consists essentially of an ion exchange membrane made of a fluorine-containing polymer having a specified fixed ion concentration, water content and ion exchange capacity, the ion exchange membrane having a thickness of from

0.1-300 μm and a moisture content of from 1-10% by weight, the membrane having a specified water vapor permeation rate. See column 2, lines 58-67. Note also column 3, lines 14-22. See, further, column 6, lines 12-18 and 39-53; column 7, 38-40; and column 8, lines 14 and 15.

Initially, it is emphasized that Nakao, et al. discloses vapor permselective membranes for production of moisture-reduced air, or for removal of moisture. In contrast, each of Kawazu and of Karakane, et al. are directed to fuel cell structures, for humidifying (that is, adding moisture) to fuel/oxidizing gasses. In view of the differences in technologies involved in Kawazu and Karakane, et al., on the one hand, and in Nakao, et al., on the other, and different problems addressed by each, it is respectfully submitted that one of ordinary skill in the art concerned with in Kawazu and in Karakane, et al. would not have looked to the teachings of Nakao, et al. In other words, it is respectfully submitted that Kawazu and Karakane, et al., on the one hand, and Nakao, et al., on the other, are directed to non-analogous arts.

Furthermore, noting particularly that Nakao, et al. is directed to a membrane for removing moisture, it is respectfully submitted that the Examiner has pointed to no proper motivation for combining teachings of the applied references. Of course, such motivation for combining the teachings of the applied references is necessary, for satisfying requirements of 35 USC 103.

In any event, even assuming, arguendo, that the teachings of Nakao, et al. were properly combinable with the teachings of either of Kawazu or Karakane, et al., it is respectfully submitted that the combined teachings of these applied references would have neither disclosed nor would have suggested the presently claimed subject matter, including, inter alia, dimensions of the water-retaining layer and functioning thereof (as set forth in the "whereby" clause in each of the independent claims).

The contention by the Examiner in the last four lines on page 5 of the Office Action mailed August 3, 2006, that Nakao, et al. is relevant “because the membrane disclosed is capable of being used for the production of a moisture controlled gas useful in a wide range of fields including chemical industries, electric and electronic industries” is noted. It must be emphasized, however, that Nakao, et al. is directed to membranes useful in removing moisture, directly opposite to the humidifier in Kawazu and in Karakane, et al. Clearly, one of ordinary skill in the art concerned with in Kawazu and Karakane, et al., would not have looked to the moisture-reducing membrane of Nakao, et al.

It is to be noted that while Nakao, et al. discloses use of the membranes described therein “in a wide range of fields”, such “wide range” does not specifically refer to fuel cells, and clearly does not refer to humidification apparatus. It is respectfully submitted that the disclosure of Nakao, et al. would have taught away from the subject matter of the present invention, and the humidification of Kawazu and of Karakane, et al.

It is again emphasized that Nakao, et al. discloses moisture-removing membranes, for removing moisture from a gas such as air or natural gas. It is respectfully submitted that such disclosure in Nakao, et al. would have destroyed the teachings of Kawazu and of Karakane, et al. for their intended purpose, of humidifying gasses passed to a fuel cell. Particularly in view thereof, the combination of teachings as applied by the Examiner is clearly improper. See In re Ratti, 123 USPQ 349 (CCPA 1959).

The additional contention by the Examiner that where general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation, is noted. As can be seen in the

foregoing, Applicants respectfully traverse the contention by the Examiner that the prior art teachings of Kawazu, Karakane, et al. and Nakao, et al., as properly combinable, disclose the general conditions of the present claims, including dimensions and recited functioning of the water-retaining layer. Furthermore, it is respectfully submitted that through dimensions of the water-retaining layer as in the present claims, the layer can function as recited in the presented claims. It is respectfully submitted that Applicants have not merely discovered "the optimum or workable ranges by routine experimentation", but rather provide a water-retaining layer that can function as recited in the present claims.

It is respectfully submitted that the additional teachings of Mossman would not have rectified the deficiencies of the previously discussed references, such that the presently claimed invention as a whole, set forth in claims 5-7, would have been obvious to one of ordinary skill in the art.

Mossman discloses membrane exchange humidifiers, particularly for use in humidifying reactant streams for solid polymer electrolyte fuel cell systems. This patent discloses that the microporous polymer membrane includes a hydrophilic additive or filler, and that the water permeable membrane preferably comprises sufficient hydrophilic additive to render it wettable to water. See paragraph [0002] on page 1 of this patent document, as well as paragraphs [0012] and [0014]-[0017] on pages 2 and 3. Note particularly the average pore size set forth in paragraph [0016] on page 2. Note also paragraph [0034] on pages 4 and 5 of this patent document.

Even assuming, arguendo, that the teachings of Mossman were properly combinable with the teachings of each of the other references applied in rejecting claims in the Office Action mailed August 3, 2006, such combined teachings would have neither disclosed nor would have suggested the presently claimed subject

matter, including, inter alia, dimensions of the water-retaining layer and functioning thereof, and advantages thereof; or the other features of the present invention as in the dependent claims, as discussed previously, and advantages thereof.

It is respectfully submitted that the additional teachings of No. 8-138705 would not have rectified the deficiencies of the teachings of the other references as applied by the Examiner in Item 13 on page 8 of the Office Action mailed August 3, 2006, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

No. 8-138705 discloses a hydrogen gas humidifier constituted with a porous film, a catalyst reaction layer formed on its one side surface, and separators which interpose the porous film and the catalyst reaction layer from both sides and form a hydrogen gas flow path and a water flow path respectively. Water in the water flow path permeates the porous film and the catalyst reaction layer according to a difference between the pressure of water flowing in the water flow path and the pressure of hydrogen gas flowing in the hydrogen gas flow path.

Even assuming, arguendo, that the teachings of No. 8-138705 were properly combinable with the teachings of the other references applied by the Examiner in Item 13 on page 8 of the Office Action mailed August 3, 2006, such combined teachings would have neither disclosed nor would have suggested features of the present invention as discussed previously, including dimensions of the water-retaining layer and functioning thereof (as set forth in the “whereby” clause in each of the independent claims).

It is respectfully submitted that the teachings of Karakane, et al., Nakao, et al. and Kawazu would have neither disclosed nor would have suggested the subject

matter of claim 16. Note the rejection thereof in Item 14 on pages 8 and 9 of the Office Action mailed August 3, 2006.

The teachings of each of Karakane, et al., Nakao, et al. and Kawazu have previously been discussed. Applicants maintain their position as to impropriety of combining teachings of Nakao, et al. with the teachings of Karakane, et al. and of Kawazu.

However, even assuming, arguendo, that the teachings of these references were properly combinable, such combined teachings would have neither disclosed nor would have suggested the presently claimed invention, including dimensions of the water-retaining layer and functioning thereof, as recited in all of the present claims, and advantages thereof.


In view of all of the foregoing comments and amendments, reconsideration and withdrawal of the Finality of the Office Action mailed August 3, 2006, whereby present amendments are entered as a matter of right; and reconsideration and allowance of all claims presently pending in the above-identified application, are respectfully requested.

In any event, entry of the present amendments, and reconsideration and allowance of all claims pending in the above-identified application, are respectfully requested.

Applicants request any shortage in fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case 520.43216X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

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